

## ABSTRACT OF THE DISCLOSURE

A Compton Deconvolution Camera (CDC) comprises multiple detection layers, position sensing logic to determine positions of events in each detection layer, a coincidence detector to detect pairs of coincident events resulting from Compton scattering, and processing logic. For each of multiple subsets of one of the detection layers, the processing logic associates data representing detected events with a distribution of corresponding events in another detection layer. The processing logic applies a deconvolution function to localize probable source locations of incident photons, computes probable Compton scattering angles for event pairs, and uses the probable source locations to reconstruct an image. Each of the detection layers may comprise an array of solid-state ionization detectors, or a scintillator and an array of solid-state photodetectors. A hybrid detector may include one layer comprising an array of solid-state ionization detectors and another layer comprising a scintillator and an array of solid-state or photomultiplier photodetectors.